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# Nominal taxa of *Spalerosophis diadema* (Schlegel, 1837) from Iraq to Pakistan – two centuries of confusion (Reptilia: Squamata: Colubrinae)

Beat SCHÄTTI[1], Ivan INEICH[2] & Christoph KUCHARZEWSKI[3]

[1] Apartado postal 9, San Pedro Pochutla, Oaxaca 70900, República Mexicana. [beatschaetti@hotmail.com]

[2] Département de Systématique et Evolution (Reptiles), Muséum National d'Histoire Naturelle, CNRS UMR 7205 (Origine, Structure et Evolution de la Biodiversité), case courrier n° 30, 25 rue Cuvier, 75005 Paris, France. [ineich@mnhn.fr]

[3] Bernauer Straße 35A, D-13507 Berlin, Germany. [C.Kucharzewski@gmx.de]

**Nominal taxa of *Spalerosophis diadema* (Schlegel, 1837) from Iraq to Pakistan – two centuries of confusion (Reptilia: Squamata: Colubrinae).** - The original descriptions of nominal species-group taxa of *Spalerosophis diadema* (Schlegel, 1837) from Iraq to Pakistan are scrutinized, the status of extant and presumably lost type specimens and alleged original series assessed, scale characters of populations from the Euphrates to the Indus Valley analyzed, and taxonomic implications discussed. The origin of the supposedly missing type material of *Coluber diadema* Schlegel (vicinity of Bushehr, Iran) remains inconclusive. Morphologically, its description best fits *S. d. cliffordii* (Schlegel, 1837) from North Africa to Iraq and Khuzestan (Iran). *S. d. schirasianus* (Jan, 1863) is a distinct subspecies from Turkmenistan and the Zagros Range to Baluchistan (Pakistan). Eastern Diadem snake populations, yet to be properly named, are referred to as *S. d. diadema* auct.

**Keywords:** *Spalerosophis diadema* - species-group - nominal taxa type series - taxonomy - morphology - systematics - type locality.

## INTRODUCTION

*Spalerosophis diadema* (Schlegel, 1837) is a wide-ranging colubrid snake of the semi-arid belt from West Africa to Central Asia and the northwestern Indian Peninsula. Marx (1959), the first reviser of *Spalerosophis* Jan, 1865, assigned Asian populations to the nominate subspecies from India and Pakistan, the Saharo-Arabian *S. d. cliffordii* (Schlegel, 1837), and *S. d. schirasianus* (Jan, 1863) from Turkmenistan and most of Iran to Uzbekistan including the Fergana Valley (Kyrgyzstan, Tadzhikistan) and Baluchistan, Pakistan.

For a while, we felt that *Spalerosophis diadema* can hardly be deemed having been thoroughly studied throughout its entire range of distribution, and in particular the Middle East. A closer look at the original references of nominal subspecies of the Diadem snake that occur in this area (*S. d. diadema*, *S. d. cliffordii*, *S. d. schirasianus*)

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and an evaluation of the pertinent literature, with special emphasis on morphological data, confirm that the systematics and taxonomy of *S. diadema* from the Euphrates and the Caspian Sea to the Indian subcontinent are in need of clarification. This statement holds true despite, and partly due to, a recent contribution on that topic by Baig & Masroor (2008).

Beyond an appraisal of the descriptions and early relevant works on *Spalerosophis diadema* ssp., this study addresses the current set of taxonomic and systematic difficulties encountered in populations from the Middle East to the Indian Peninsula, i.e., focuses on distinctive characters and the homeland of *S. d. diadema* (Schlegel), the eastern distribution limit of *S. d. cliffordii* (Schlegel), and the validity of *S. d. schirasianus* (Jan).

## MATERIAL AND METHODS

### Structure of paper, geographic scope, and data

For the sake of intelligibility, and apart from the presentation of the systematic concept followed in this paper, the results section is split into a historical and an analytical part. The former is purely descriptive, scrutinizes the original publications as well as antecedent and contemporary contributions to, and illustrations of, the nominal species-group taxa under consideration with emphasis on the provenance and morphological features of the type series, and sets forth comments necessary for the understanding of the taxonomic context.

The comparative account analyzes the intraspecific variation of head and body scales (prefrontal, supralabial, perioculars; ventrals, subcaudals, longitudinal dorsal rows). Morphological data compiled in that chapter are from literature. If not indicated in the respective publication, the gender of specimens is inferred from their number of ventrals (see Tb. 2). Populations dealt with basically range from south of approximately 34°30'N (Jabal Hamrin) and east of roughly 43°45'E (Fallujah area) in Iraq to eastern Turkmenistan (Amu Darja) and Pakistan; Marx's (1959) condensed data include one specimen from western Kurdistan. For reasons explained elsewhere (Systematic Concept: second paragraph), Indian references of *Spalerosophis diadema* auct. are not considered in this study.

## TERMINOLOGY

The term 'supranumeral scutes' denotes any scales on the pileus beside the ordinary nine shields usually found in colubrines, and in particular those regularly observed in the prefrontal region. 'Prefrontals' are used as utilized by Jan (1863), i.e., refers to all dorsal head scales between the internasals and the anterior borders of the frontal and supraoculars; laterally, the prefrontals may reach the upper loreal region (Fig. 1B). 'Loreals' are situated on or above a straight line parallel to the mouth from the lower posterior tip of the nostril to the periocular ring; the uppermost loreal, in contact with the prefrontals, usually encroaches to some extent beyond the canthus rostralis (Figs 1A, 2). Scales below this demarcation and bordering the supralabials, but not touching the orbit, are referred to as 'secondary labials'. 'Perioculars' are all scales in contact with the eye except the supraocular plate; the first is the large upper

"preocular" (auct.). The maximum of longitudinal dorsal scale rows in *Spalerosophis* spp. may occur immediately in front of midbody (50% of the total number of ventrals) as exemplified by the type species, *S. microlepis* Jan, 1865 (Schätti *et al.*, 2009a). For the purpose of this study, midbody dorsal scale rows ('msr') denote the maximum along the trunk, and not necessarily the count exactly at midbody.

The interpretation of prefrontal data from literature is tricky. For instance, "eight to 11" and "six to nine" prefrontals for *Spalerosophis d. diadema* auct. and *S. d. schirasianus*, respectively, reported by Minton (1966) are most probably made up of all scutes along the outer border of the larger central prefrontals and may in particular include the uppermost loreal that extends to various degrees onto the pileus (e.g., Jan & Sordelli, 1867: Pl. II; Figs 1A, 2). Furthermore, a printing lapsus cannot be ruled out, as Minton (1966) noted the same range ("eight to 11") in the case of perioculars for the nominate subspecies. Reservations also exist regarding Hellmich's (1959) description of scales in the prefrontal region (see Discussion). The undefined term "frontonasals" sensu Baig & Masroor (2008: Tb. 1) probably refers to larger prefrontals in contact with the internasals. Supplementary "fronto-nasales" or "frontales antérieures" as described by Duméril *et al.* (1854: 678 [footnote], 679) actually refer to identical configurations (Fig. 2) and the terminological distinction is futile. Zugmayer (1905) used "Frontonasalia" instead of internasals.

Günther (1864) reported "about fourteen" supralabials but only thirteen are shown in his illustration (Pl. XXI.G). Werner's (1936) "Postocularia" actually also contain all suboculars (auct.) and were converted into perioculars by adding two scales (preoculars auct.), which is a moderate position. The definiton of "ocular scales in the ring about the orbit" (Schmidt, 1930) or "scales in ocular ring" (Marx, 1959) is ambiguous; it remains unclear whether or not these terms comprise, for example, the supraocular plate, and Marx's (1959) data encompass circumocular scales not entering the eye (Schätti *et al.*, 2009a).

Ventral data indicated in literature may usually include one or two preventrals. The exceedingly high count "278" in a specimen from "Gilgit" (Boulenger, 1893) is excluded from analysis. Wall's (1911b) report of 251 ventrals for an alleged male from Chitral (coll. "15-3-10") is considered to belong to a female; this is also the case with a Diadem snake ("♂", 236 ventrals) from "Harmaleh" (Goteysh, 31°57'N 48°34'E), Khuzestan (Hellmich, 1959). "207" ventrals and "60" subcaudals in a probable male from Fallujah (Corkill, 1932) are outliers, most likely based on a counting or printing error (217?) and, respectively, an incomplete tail. This may also be true for "sixty-six pairs" of subcaudals in a specimen from "Karmán" (Blanford, 1876; see Boettger, 1888). "27" subcaudals reported by Afrasiab & Ali (1989) were changed to 72. The dorsal scale count "26" mentioned by Khan (1986) had most probably not been taken at midbody; even values ("26" and "28") in Zugmayer (1905), Mertens (1956), and Baig & Masroor (2008) are understood to correspond to a maximum along the trunk of at least 27 and 29, respectively (see above).

### Material examined

We examined the five extant syntypes of *Periops parallelus* Duméril, Bibron & Duméril, 1854 (MNHN 3571-3574 and 1999.8250) and, through courtesy of Ronald de

Ruiter (Leiden), have photographs showing dorsal, lateral (left side) and ventral views of the head as well as the underside of the tail (subcaudals) of two paralectotypes of *Coluber cliffordii* Schlegel, 1837 (RMNH 467A-B) registered as "syntypes" from "Tripoli". To conclude from the aberrant condition of the supralabials (i.e., seventh in contact with eye on left side) and the total number of secondary labials and loreals (six) as well as size, the letters 'a' and 'b' are in reversed order vis-à-vis Kramer & Schnurrenberger's (1963) notation. Most probably, these individual labels were attached after 1963; we denote the specimens in line with the RMNH register.

### Acronyms

Acronyms mentioned in the text are BMNH (The Natural History Museum [British Museum (Natural History)], London), FMNH (Field Museum of Natural History, Chicago), MCZ (Museum of Comparative Zoology, Harvard University, Cambridge), MHNG (Muséum d'Histoire naturelle, Genève), MNHN (Muséum National d'Histoire Naturelle, Paris), MSNG (Museo Civico di Storia Naturale 'Giacomo Doria', Genova), MSNM (Museo Civico di Storia Naturale, Milano), PMNH (Pakistan Museum of Natural History, Islamabad), RMNH (Rijks Museum voor Natuurlijke Historie [Nationaal Natuurhistorisch Museum, National Museum of Natural History] 'Naturalis', Leiden), SK (collection of the late Eugen Kramer, now mostly stored in the MHNG), SMF (Forschungsinstitut und Naturmuseum Senckenberg, Frankfurt/Main), and USNM (National Museum of Natural History [Smithsonian Institution, United States National Museum], Washington).

## RESULTS

### Systematic Concept

Schmidt (1930) revalidated *Spalerosophis* Jan for *S. microlepis* Jan, 1865 (type species) from West Iran, *S. arenarius* (Boulenger, 1890) of India and Pakistan, and *S. diadema* (Schlegel, 1837) from "Morocco to Turkestan and the Indian Peninsula". Schätti *et al.* (2009a) recently published an appraisal of the genus with a key to the six currently recognized species including *S. atriceps* (Fischer, 1885) from North India and adjacent areas, the Maghrebian *S. dolichospilus* (Werner, 1923), and the remarkable *S. josephscorteccii* Lanza, 1964 only known from the type locality (Galgalo Oasis) in Northwest Somalia (Puntland).

Marx's (1959) nominate subspecies of *Spalerosophis diadema* is made up of "typical *d. diadema*" and "the strikingly different color variety '*atriceps*'" which he believed to be "a synonym of *d. diadema*." Contrary to this widespread view (e.g., Mertens, 1969; Khan, 2006; Hallermann, 2007), we follow Minton (1966) and Baig & Masroor (2008) who consider *Zamenis diadema* ["Var."] *atriceps* Fischer a valid species of the *S. diadema* group sensu Schätti *et al.* (2009a) encompassing *S. arenarius*, *S. diadema*, and *S. dolichospilus*. *S. atriceps* and *S. diadema* unmistakably differ in their respective adult head and body colour pattern (e.g., Wall, 1914: Pl. XXIII; Smith, 1943: Figs 51-52; Minton, 1966: Pls 25.3-27.1) but juveniles and subadults look very similar ("conform to one type", Wall, 1914) and are, at least by the current standard of knowledge, hard to distinguish, in particular from literature data [1]. Sympatry of *atriceps* and *diadema* is confirmed for Pakistan (e.g., Minton, 1966;

Mertens, 1969) but, as a consequence of existing systematic confusion, the presence of *diadema* in India is a matter of disagreement; Baig & Masroor (2008: Fig. 7), for instance, only mapped *atriceps*. To judge from a survey of literature, the Indian distribution range of *Spalerosophis* spp. (*atriceps*, *diadema*) extends to Gujarat (Kutch) in the south, Rajasthan, and east to Uttar Pradesh (Whitaker & Captain, 2004 [as *S. atriceps*]). Specimens from Southeast Nepal briefly discussed in Schätti *et al.* (2009a) belong to *atriceps* as evidenced, for example, by Shah & Tiwari (2004: photograph); however, this picture is from an animal kept by a snake charmer (Karan B. Shah in litt.) and autochthonous records, at least for the Kathmandu Valley, await confirmation. Although the Diadem snake most probably occurs in Northwest India (e.g., Kashmir, Punjab), we refrain from including literature data about *Zamenis* or *Coluber* (auct.) "*diadema*" as documented, for example, from Haryana (Ambala), Rajasthan, and western Uttar Pradesh (Agra) by Boulenger (1893), Constable (1949) or Biswas & Sanyal (1977) because these records (incl. BMNH material, MCZ 3766) are based on subadults (600 mm snout-vent length or less) or specimens without indication of size (Boulenger, 1893).

Schlegel (1837) thought the type locality of *Spalerosophis diadema* to be in the vicinity of Mumbai, India ("environs de Bombay"), but Wall (1914) and Mertens (1940) demonstrated that the original series, first reported and described by Russell (1807), is from the northern part of the Persian Gulf ("from Buchier"). Despite this, Schlegel's (1837) erroneous view regarding the provenance of the type material (see Early Descriptions) found many followers including Schmidt (1939) and his alumnus Marx (1959).

Upon examination of twelve FMNH specimens from the vicinity of Teheran, Schmidt (1939) realized that Iranian populations of *Spalerosophis diadema* are "well distinguished from the so-called *diadema* of Iraq" and declared species status for *cliffordii* and *schirasianus*. Mertens (1940) noted minor differences in colour pattern (dorsal markings not roundish) of Diadem snakes from the Teheran area (SMF material) vis-à-vis two *schirasianus* shown in Jan & Sordelli (1867: Pl. II) ("Die Rückenflecke haben [...] eine ziemlich runde Form, die bei meinen Exemplaren nicht in Erscheinung tritt") and referred his specimens to the nominate subspecies because they largely agreed with Russell's (1807) illustration of the lectotype in colour pattern and scale features ("stimmen [...] in der Zeichnung wie in der Beschilderung [...] weitgehend überein").

Schmidt (1939) ranked *Coluber cliffordii* Schlegel, *C. diadema* Schlegel, and *Periops parallelus schirasianus* Jan as valid species (for reservations see Discussion: penultimate paragraph); this opinion was rarely followed, for instance by Schmidt &

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[1] Minton (1966) observed "keeled" dorsals in *Spalerosophis atriceps* versus smooth or weakly keeled scales in Pakistani *S. diadema*. However, it is not known whether these character states do hold for juveniles and subadults, and literature about *Spalerosophis* spp. from Pakistan and India lacks specific information. The elaboration of distinctive features that apply to smaller specimens is a matter of priority. Apart from the degree of keeling of the dorsal scales, the number of loreal scales (and their distinction from prefrontals) or, for instance, details of the maxillary as the condition of the interspace (present or absent) or the size of the postdiastemal teeth (enlarged or not) are of potential systematic significance within the *S. diadema* complex.

Marx (1957), Khalaf (1960) and Latifi (1991) in the case of *Spalerosophis cliffordi* [sic] and Schmidt (1955) for *S. shirazianus* [sic]. Recently, Trape & Mané (2006) conferred species status to Clifford's Diadem snake because of homogeneous scale characters compatible with literature data for this taxon but clearly different from *S. diadema* ("j'ai basé ma décision sur le fait que ma série de spécimens d'Afrique de l'Ouest était très homogène en compte d'écailles, bien différente de ce qui était publié pour *S. diadema*, mais compatible avec *S. cliffordi* [sic] qui avait été initialement décrit comme une bonne espèce", Jean-François Trape in litt.). In former times, Günther (1864) considered *cliffordii* and *diadema* (as *Zamenis* auct.) distinct species due to "keeled ventral shields" and "small shields behind the frontals" in the latter, i.e., between the larger prefrontals and the frontal ("vertical"). Strauch (1873) only mentioned *Z. cliffordii*. Blanford (1881) assigned a Diadem snake from Dehbid (see Morphological Variation) with the latter condition but the ventrals "not distinctly angulate" to *Z. Cliffordi* [sic], noting that this taxon and *diadema* "are scarcely separable, as I have shown ('Eastern Persia', ii. p. 413)." Boettger (1888) distinguished these nominal species by the number of subcaudals (see Discussion: third paragraph).

Contrary to Schmidt (1939), Marx (1959) used trinominals for the *Spalerosophis diadema* complex including *S. atriceps* (see second paragraph above) and recognized *S. d. schirasianus* for populations from "the Zagros Mountains of western Iran eastward through southern Turkmen and Afghanistan into Pakistan and India, where it meets with *d. diadema*". The easternmost *schirasianus* are mapped in Baluchistan (Pakistan, then part of India) and, despite his blunder regarding the type locality of the nominate subspecies ("near Bombay"), not a single record of *S. diadema* from Mumbai or its farther vicinities appears; actually, the indicated distribution range of *Spalerosophis* spp. (*atriceps*, *diadema*) on the Indian Peninsula is restricted to areas north of a line from Sind (vicinity of Karachi) to Uttar Pradesh. Without taking into account the data of the lectotype of *Coluber diadema* Schlegel (see Early Descriptions), Marx (1959) diagnosed *cliffordii* (east to "extreme western Iran") by "less than 80" subcaudals versus at least 80 in more eastern subspecies (*diadema*, *schirasianus*), and "usually less than 100" in *schirasianus* vis-à-vis "usually 100 or more" in *diadema*.

Lanza (1964) discussed taxonomic implications with regard to *Coluber tyria* Linnaeus, 1758 re-introduced by Terentjev & Chernov (1936), a putative senior synonym of *C. diadema* Schlegel proposed to be rejected (see Mertens, 1940; Schätti *et al.*, 2009b), and drew attention to the exceedingly low number of subcaudals in the lectotype of *C. diadema* (see Discussion). Relying on Wall's (1914) comments regarding the type locality of *Spalerosophis d. diadema* and the distribution of the species in India, Minton (1966: 126, footnote) doubted the presence of *S. diadema* "near Bombay." Although body scale data of the type series point to a different origin ("the ventral and subcaudal counts given for the specimen are those of a snake of Iranian rather than Indian origin"), he recognized the "typical" morph of *S. d. diadema* sensu Marx (1959) from Pakistan and India ("western part of the United Provinces") and *S. d. schirasianus* from "Transcaspia [...] east to Tadzhikistan" and south to Baluchistan ("Quetta and western Las Bela").

Baig & Masroor (2008) came to the conclusion that *Periops parallelus schirasianus* Jan "is a junior synonym" of *Coluber diadema* Schlegel and applied the nominate species-group name to Diadem snake populations from Turkmenistan to Pakistan. Schätti *et al.* (2009a) were reluctant to accept this assumption and reminded the reader of the problematical distinction of subspecies in Southwest Iran and the taxonomic complication due to the supposed origin of the type series of *C. diadema* from that area.

In the following text, we recognize *Spalerosophis d. cliffordii* (Schlegel) from North Africa to Oman, Southeast Turkey, and Southwest Iran (Khuzestan) vis-à-vis *S. d. schirasianus* (Jan) from Turkmenistan to the Fergana Valley (Kyrgyzstan, Tadzhikistan) and south along the Zagros Range in Iran to western Pakistan (Baluchistan), and use 'eastern *diadema*' as a modus operandi for populations of Diadem snakes (*S. d. diadema* auct.) from east of approximately 67°E longitude in southern Pakistan to the southeastern escarpment of the Hindukush in Afghanistan and Chitral. Except for the remarks found in this section, we recommend the maps in Marx (1959), Lanza (1964), Gasperetti (1988), Trape & Mané (2006), and Baig & Masroor (2008) as basic references to grasp an idea of the distribution limits of the various taxa of the *S. diadema* group of species.

### Early descriptions

***Spalerosophis d. diadema*** (Schlegel, 1837)

["*Coluber*"] Russell, 1807: 34, Pl. XXX - "from Buchier" (type series see smallprint).
*Coluber diadema* Schlegel, 1837: 146 [vol. 1], 148 [2] - "pris dans les environs de Bombay" (see text).

The description of *Coluber diadema* and other new taxa including *C. cliffordii* in Schlegel (1837) is, or at least comprises, the text of the first volume ('Partie générale'). However, distinguished authorities (e.g., Duméril *et al.*, 1854; Günther, 1864; Boulenger, 1893; Marx, 1959) dealing with *diadema* or *cliffordii* (or both) cite only the second volume ('Partie descriptive'), an imprudence that also sneaked into Schätti *et al.* (2009b: 53). Opinions 1384 and 1856 (ICZN 1986, 1996), for instance, ruling on specific snake names (*Dendrophis* [*Dromophis*] *praeornata*, *Psammophis* [*Lycognathophis*] *seychellensis*) established by Schlegel (1837) attribute the original references to both volumes of the 'Essai sur la physionomie des serpens' ("vol. 1, p. 157, vol. 2, p. 236") or just "vol. 1 (Partie générale), p. 155", respectively. For the sake of clarity, we quote both and opted for the more detailed information regarding the origin of the type series as indicated in the 'Partie descriptive'.

Schlegel (1837, vol. 2) described the species upon Russell's (1807) illustration and text ("J'introduis cette belle espèce d'après la figure qu'en a donnée Russel [sic] II Pl. 30 p. 34") and erroneously reported the then syntypes from the vicinity of Mumbai. Russell (1807) averred that "[t]wo specimens in good preservation were received from Dr. Scott, of Bombay [Mumbai], sent to him from Buchier, by Mr. Bruce", i.e., Bushehr (Bushire) on the Gulf coast in Iran (Wall, 1914; Mertens, 1940; Minton, 1966; Wallach in Baig & Masroor, 2008).

The illustrated snake (Russell, 1807: Pl. XXX) is the smaller individual, as evidenced by the ventral scale count (220) and the fact that the drawing undoubtedly shows a male. Russell (1807) described that specimen adequately and Mertens (1940)

referred to it as the "Typus von *diadema*" or "*diadema*-Typus". This constitutes a lectotype designation (ICZN, 1999: Art. 74.5); the larger paralectotype ("Paratypoid") is most probably a female (see Morphological Variation, Tb. 2). No "types" of *Coluber diadema* Schlegel are listed in Boulenger's (1893) 'Catalogue'. Pending further investigations, the original material "may be lost" (Schätti *et al.*, 2009a).

Some herpetologists (e.g., Daudin, 1803a-b; Schlegel, 1837) who described new species upon Patrick Russell's 'Indian serpents' (1796, 1801-1809) relied on the text and plates in the various sections of this pictorial atlas. Although many mentions of "Russell" in Boulenger's (1893-1896) synonymies are not documented by material, it would be wrong to conclude that they were established without access to specimens; some were perhaps presented by Russell himself or received in the first half of the 19th century, as in the case of *Coluber* [*Dryocalamus*] *nympha* Daudin, 1803a (Kucharzewski & Tillack, 2008); others were obtained and incorporated into the collections of the former 'British Museum (Natural History)' at the very end of Boulenger's professional career as, for instance, the holotype of *Enhydrina schistosa* Daudin, 1803b donated by the Royal College of Surgeons in 1921 (see Wall, 1909); this species is based on Russell's (1801: p. 11, Pl. X) 'hoogli pattee' (fide Smith, 1926). Further specimens may be concealed among the "collection of Indian Reptiles made by Dr. Patrick Russell, containing the types of the species described by him in [...] 1796" and stated to be "preserved as skins" (Boulenger, 1906: 518, 530, see below). Skins mounted on paper or parchment and apparently received in 1837 ("purchased from Mr Sotherby") are registered as from the "Burmese Empire"; unfortunately, they are without a more precise reference, in particular any hint to Russell (Colin McCarthy in litt.). To judge from notes on these sheets, it seems that John Edward Gray was intending to include them in his inventory of snakes, an idea later abandoned perhaps because he decided that the source was too tenuous; however, preserved complete specimens ("In spirits") are listed (Gray, 1849: e.g., pp. 24, 30, 48). Similarly, Günther (1858, 1864) wholly ignored these skins, and Smith's (1943: 531-532) identification list of Russell's snakes does not assign the illustrations to actual holdings including preserved specimens at all. Boulenger (1906: 528) reported further "skins of Indian Snakes [...] including the original examples described by this pioneer in Indian Herpetology" purchased in 1904, roughly one hundred years after Russell's death in 1805. Compelling evidence linking nearly one hundred catalogued items (BMNH 1904.7.27.1-97) with the 'Indian serpents' is found in the register, i.e., an entry in Boulenger's handwriting dating from July 1904 documenting "snake-skins from India, prepared by Dr Patrick Russell" purchased from a descendent; although clearly involved personally, George Albert Boulenger nevertheless did not make any attempt to retrieve the plates of the 'Indian serpents'. By all means, no serious efforts to locate material first described and figured in the 'Indian serpents' were made in modern times. This recently resulted in the designation of a neotype for *Coluber tristis* Daudin, 1803a by Rooijen & Vogel (2008) who believed Russell's specimens to be stored in Paris (MNHN), the working place of François Marie Daudin ("Daudin did not deposit a type-specimen in a collection as was usual at that time").

There "appear an unusual row of small laminae" behind the "sub-triangular" prefrontals which are larger than the internasals (Russell, 1807). The portrayal shows three scales separating the larger prefrontals from the frontal and two (one on each side) additional supranumeral scutes in front of the supraoculars; on the left, there are three (two lower, one upper) loreals and two or three secondary labials. Russell (1807) reported 220 ventrals and 61 "Squamae Subcaudales" for the lectotype (see Discussion) and 238 ventrals ("abdominal scuta") in the paralectotype. The dorsals are "oval, smooth, and every where very small in size" but they are keeled ("carénées", see footnote 1) according to Schlegel (1837).

The parietals are "marked with four darkish dots" (Russell, 1807). The dorsum is "cineritious, with large darkish ragged spots along the ridge of the back, while others smaller and more faint are scattered on the sides. The abdomen and under part of tail are uniformly white without spots." Schlegel (1837) described the dorsal coloration as

brown like earth ("brun de terre" [vol. 1], "la teinte d'un brun couleur de terre" [2]) and mentioned the transverse dark band between the eyes.

***Spalerosophis diadema cliffordii*** (Schlegel, 1837)

*Coluber guttatus* Forskål, 1775 [non *C. guttatus* Linnaeus, 1766]: 14 - "Ad Káhiram" [vicinity of Cairo] (supposed holotype not located, see Schätti *et al.*, 2009b).
*Coluber cahirinus* Gmelin, 1789: 1115 (nomen novum for *C. guttatus* Forskål, 1775).
["Couleuvre aux raies parallèles"] Geoffroy Saint-Hilaire, 1827: 147, Pl. 8.1 ("Égypte": incl. MNHN 3572, 3574).
*Col.[uber] versicolor* "Opp.[el]" Wagler, 1830 [non *C. versicolor* Razoumowsky, 1789, non *C. versicolor* Merrem, 1820]: 189, footnote 5 - origin not indicated (see second paragraph).
*Col.[uber] Geoffroyii* [sic] Gray, 1831: 87 - ["Egypt"] ("Coulévre [sic] aux raies paralleles [sic], Geoff. Rept. Egypt").
*Coluber cliffordii* Schlegel, 1837: 148 [vol. 1], 163 [2], Pl. VI.13-14 - "États barbaresques" [Tripoli, Libya] (incl. RMNH 467A-B, see text, Material, and *Spalerosophis d. diadema*: first paragraph).
*Periops pyramidum* Gistel, 1848: 100 - ["Egypt"] ("Geoffr. Descript. de l'Egypte etc. 8. f. 1").
*Periops parallelus* Duméril, Bibron & Duméril, 1854: 678 - "originaire d'Egypte" [Egypt, Tunisia (Sfax) and "sur les bords de la mer Rouge"] (incl. MNHN 3571-3574 and 1999.8250 [formerly 3574A]).

*Coluber cahirinus* Gmelin (new replacement name for the primary homonym *C. guttatus* Forskål) and *C. geoffroyii* Gray are nomina oblita (Schätti *et al.*, 2009b). The junior synonym *Periops pyramidum* Gistel, valid by indication (ICZN, 1999: Art. 12.1-2), is an overlooked name re-discovered by Mertens (1921). As far as we are aware, and apart from Sherborn's (1929) 'Index animalium', it was only used by Gistel (1848, 1850); Gistel (1868) did not mention this specific name.

*Coluber versicolor* Wagler, established upon a label name coined by Nikolaus Michael Oppel in the "Pariser Museum", is preoccupied; this name was rarely cited, but considered valid, in literature (e.g., Boettger, 1885, 1888). Although irrelevant for technical purposes, we take this opportunity to emphasize that the oldest catalogue of the herpetological collections of the MNHN dating from 1864 [manuscript] lists ten specimens of *Spalerosophis diadema* (as *Zamenis parallelus* [MNHN 3571] and *Z. diadema*); apart from the type series of *Periops parallelus* Duméril, Bibron & Duméril, these are MNHN 1904.559 and 1904.560a-c collected by Jacques de Morgan in "Perse", which arrived at the museum at the beginning of the last century. The supposition that *C. versicolor* Wagler hailed from northern Africa (Boettger, 1885) is entirely based on Wagler's (1830) indication of the distribution of *Periops* spp. auct. ("Europa, Africa") to which *versicolor* was assigned. There is no trace of, nor hint to, Oppel's specimen, and the matter is open to speculation, e.g., that it may have been among the series available to Geoffroy Saint-Hilaire (1827). Gistel (1848) introduced his name as "*Periops pyramidum* (Gistl)" [sic]. As a matter of fact, some publications by this author were published under this spelling as well as the pseudonym 'G. Tilesius' (Pieper, 1996). Due to the original citation, Mertens (1921) concluded that Johannes Nepomuk F. X. Gistel had published the specific name earlier ("muß [...] schon früher beschrieben worden sein"); however, we do not know any reference of *pyramidum* Gistel prior to 1848. Sherborn's (1929) entries give that author's name as "J. Gistl"; 1847 as year of publication of the 'Naturgeschichte des Thierreichs' ("Handb. Naturges. 1850 [1847]") is in error.

*Coluber cliffordii* Schlegel was described on the basis of an unknown number of specimens received from Clifford Cocq van Breugel, the Dutch Consul at Tripoli, Libya. This place is generally considered the type locality (e.g., Mertens, 1940; Marx, 1959). Kramer & Schnurrenberger (1963) located two of Schlegel's (1837) females in the Leiden collection ("RNHL [sic] 467", Fig. 1) and, following a suggestion by the then curator ("Wir schliessen uns dem Vorschlag von Herrn Prof. Brongersma an"), conferred lectotype status to the smaller specimen 'b', i.e., RMNH 467A (see Material), which was carelessly supposed to be ("es ist anzunehmen") the one figured in Schlegel (1837: Pl. VI.13-14). This action was apparently taken in ignorance of Mertens (1940), whose quotation of the actually illustrated individual as the "Typus von *Coluber cliffordii* Schlegel" meets the provision of Art. 74.5 of the 'Code' (ICZN, 1999) and qualifies as a lectotype designation. We do not have any information on its whereabouts.

The two RMNH specimens of Schlegel's (1837) original series are paralectotypes. None of them corresponds to the lectotype with just the nine ordinary colubrine dorsal head shields, which is definitely a highly uncommon condition for *Spalerosophis* spp. RMNH 467A shows four prefrontals of which three are in contact with the frontal; RMNH 467B has two large prefrontals; the left is separated from the frontal by a small narrow supranumeral scute (see Terminology). Based on an examination by Leo D. Brongersma, Kramer & Schnurrenberger (1963) erroneously noted a scale separating the frontal from the first periocular ("preocular") on the left side of both paralectotypes, and partial separation on the right side of RMNH 467A ('b': "Fr[ontal] rechts teilweise, links vollständig durch ein Schildchen vom Pro [preocular] getrennt"). In reality, both specimens have the first periocular in contact with the frontal on both sides.

Schlegel (1837, vol. 2) mentioned Geoffroy Saint-Hilaire's (1827) illustration as an early reference of *Coluber cliffordii* (see also Schätti *et al.*, 2009b: footnote 2). According to the 'Description de l'Égypte', the figured specimen (MNHN 3574, see smallprint and text below) measures approximately 1083 mm total length ("deux pieds huit pouces" snout-vent length and "sept pouces" for the tail). The morphological description of the "Couleuvre aux raies parallèles", however, is based on a different specimen (MNHN 3572), a female with 244 ventrals and 71 paired subcaudals (verified as 241 plus three preventrals and 72+? subcaudals; extreme tip of tail missing) measuring "deux pieds sept pouces et demi" (approx. 874 mm) total length.

The spelling of the French vernacular name is not consistent throughout the 'Description de l'Égypte'; the plural ("[Couleuvre] aux [raies parallèles]") appears in the caption of the description and illustration (Geoffroy Saint-Hilaire, 1827: 147, Pl. 8.1) as well as on page 150 (last line) but the singular ("à") is used on the same page (penultimate paragraph) and twice on the next. Schlegel (1837) and Duméril *et al.* (1854) reported Geoffroy Saint-Hilaire's (1827) account on this colubrid as on page 67 or 89, respectively (see Schätti *et al.*, 2009b: footnote 4). The figured male (MNHN 3574) was obtained by Antoine Barthélémy Clot. This physician became chief surgeon to the Egyptian viceroy Muhammad Ali Pasha ('Mehmed Ali') who bestowed on Clot the title of 'Bey' in 1832.

*Periops parallelus* Duméril, Bibron & Duméril is based on seven syntypes, but only five are catalogued: MNHN 3572 with a total length of 853 (710 + 143 mm) received from Isisore Geoffroy Saint-Hilaire as well as three fine specimens ("beaux

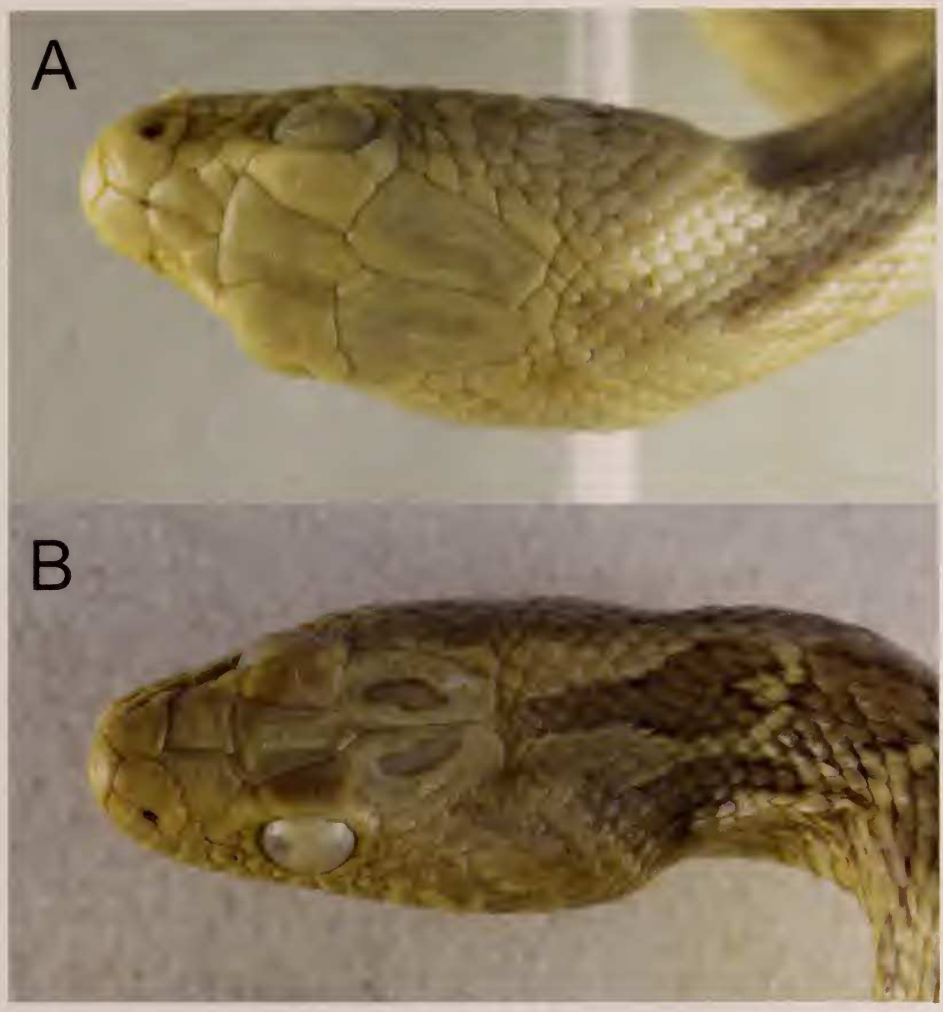


FIG. 1
Dorsolateral head view of paralectotypes of *Coluber cliffordii* Schlegel, 1837: RMNH 467A (A) and 467B (B) from "Tripoli", Libya. Not to scale. Photographs by Eelco Kruidenier.

sujets") presented by 'Clot-Bey' (MNHN 3573: 1'362 [1'190 + 172] mm; 3574: 1'070 [872 + 198] mm; 1999.8250: 1'314 [1'090 + 224] mm), all from unspecified places in Egypt and without date of acquisition, and a subadult (MNHN 3571, leg. "Spina 1853") with 418 (347 + 71) mm from Sfax, Tunisia. Two (adult, juvenile) syntypes found in shipments of Paul-Émile Botta from the Red Sea area ("sur les bords de la mer Rouge"), possibly originating from the Arabian Peninsula, do not appear in the MNHN file register; actually, they were never incorporated into the herpetological collection (according to the 1864 unpublished catalogue, see second paragraph above), but might be located in another museum.

Strangely, Duméril *et al.* (1854) cited *Coluber Cliffordii* [sic] in their list of synonyms and alluded to Schlegel (1837) in the text, as did Jan (1863) who used the junior synonym *Periops parallelus* as the valid name for the species. Furthermore, Jan (1863, 1865) erroneously considered Geoffroy Saint-Hilaire (1827) to be the author of *P. parallelus*, probably as a consequence of ambiguous remarks in the 'Erpétologie générale'. The deceptive notion of "type" in Duméril *et al.* (1854) clearly refers to Geoffroy Saint-Hilaire's (1827) oeuvre ("M. Geoffroy a déposé dans le Musée l'exemplaire qui lui [him (!)] a servi de type"), i.e., the "Couleuvre aux raies parallèles", and does not constitute a holotype designation in the sense of Art. 73.1.1 (ICZN, 1999).

According to Duméril *et al.* (1854: 678, footnote), Botta's juvenile syntype of *Periops parallelus* and "le type de M. Geoffroy" (MNHN 3572) have only nine dorsal head shields; however, the latter shows a small supranumeral scute between the left central prefrontal, the upper loreal, and the frontal. MNHN 3573 has a total of six prefrontals comprising a small azygous scale on the right; the remaining syntypes including Botta's larger specimen possess a total of four or five (MNHN 3571) scales in the prefrontal region (Fig. 2, see Terminology). Form, size, and position of the two supranumeral scutes of MNHN 3574 figured in Geoffroy Saint-Hilaire (1827: Pl. 8.1') are not accurate; there is, for instance, no separation of the first periocular from the frontal (Fig. 2D). In general, many of the illustrations and drawings in the 'Description de l'Égypte' are not very precise (Roger Bour, pers. comm.), and certainly not reliable when it comes to attribute them to museum specimens.

Schlegel's (1837: Pl. IV.14) figure of the unlocated lectotype of *Coluber cliffordii* shows ten supralabials, three secondary labials, three (two lower, one upper) loreals, eleven perioculars, and five temporals in the first and second row, respectively. Kramer & Schnurrenberger (1963) reported ten (right) to eleven (left) and eleven (left) to twelve supralabials, six and three to four "loreals" (including secondary labials), and ten or eleven perioculars in RMNH 467A and 467B, respectively (see Material). RMNH 467A has ten supralabials, three secondary labials, and three (two lower, one upper) loreals (data from photographs, supralabials only verified on left side); RMNH 467B (only left side counts) has one secondary labial, two loreals (the prefrontal extending far downwards laterally), and twelve supralabials of which the seventh enters the eye, a very unusual condition within the genus *Spalerosophis* Jan (e.g., Marx, 1959; Schätti *et al.*, 2009a).

The syntypes of *Periops parallelus* have ten (juveniles) to twelve (adults) supralabials and three (two lower, one upper) loreals; reported "anomalies" in the upper labial region ("se retrouvent [...] pour les plaques sus-labiales", Duméril *et al.*, 1854: 678, footnote) refer to the occurrence of usually two (one to three) secondary labials (see Geoffroy Saint-Hilaire, 1827: Pl. 8.1). The number of perioculars in the type series of *P. parallelus* ranges from 9 to 11.

Schlegel's (1837) counts for ventrals and subcaudals in *Coluber cliffordii* are "236 + 84" (vol. 1) or 230-240 and 66-90 (vol. 2), respectively; the minimum for subcaudals may stem from RMNH 467B and the maximum of 90 (vol. 2) is most likely erroneous. Kramer & Schnurrenberger (1963) noted 229 ventrals and 72 paired subcaudals in the smaller extant paralectotype (RMNH 467A) and 232 ventrals (67 "+?" subcaudals) in the larger. Duméril *et al.* (1854) gave 223-241 ventrals and 70-74 subcaudals for *Periops parallelus*; one male (MNHN 3574) has only 219 ventrals, and at least MNHN 3572 (72+?), 3574 (75+?), and 1999.8250 (72+?) lack the extreme tip of tail.


FIG. 2

Dorsal head view of syntypes of *Periops parallelus* Duméril, Bibron & Duméril, 1854: MNHN 3571 (A) from Sfax, Tunisia, MNHN 3572 (B), 3573 (C), and 3574 (D) from "Égypt". Not to scale.

The dorsal scales are small ("peu grandes"), lanceolate, and with strong obtuse keels ("forte carène émoussée"); probably, Schlegel's (1837, vol. 2) count of longitudinal rows (23 msr) is not the maximum at midbody (see Terminology). Brongersma

found 25 msr in RMNH 467A-B (Kramer & Schnurrenberger, 1963). Duméril *et al.* (1854) reported higher (29-31 msr) counts and noted that the median dorsal scales are more pointed and longer than those of the lateral rows, from which the former also differ in possessing obtuse keels ("à carènes peu saillantes"); this condition is more manifest towards midbody ("d'autant plus apparente, qu'on examine les écailles plus loin de la tête") and better visible in juveniles.

The dorsum is greyish brown with three series of brown spots along the trunk; those of the median row are largest and of variable shape (squarish, oval or confluent and arranged in longitudinal streaks). The dorsal markings are pale brown ("d'un brun livide") according to Schlegel (1837, vol. 2) but very distinct ("très-prononcées") following Duméril *et al.* (1854).

***Spalerosophis diadema schirasianus*** (Jan, 1863)

*P.*[*eriops*] *parallelus* "(Geoffr. S$^{t}$ Hil.) Dum. e Bibr." var. *schirasiana* Jan, 1863: 60 - "Schiraz, Persia" (MSNM, see text and *Spalerosophis diadema cliffordii*: second smallprint).

*P.*[*eriops*] *parallellus* [sic] "Geoff. var" [sic] *Schiraziana* [sic]. - Jan, 1865: 356 (incorrect subsequent spelling).

*Periops parallelus* var. *schirazana* [sic]. - Sordelli in Jan & Sordelli, 1867: inside of cover ['Index des planches'], Pl. II ("Schiraz, Perse").

Anderson & Leviton (1969) regarded *Periops parallelus* var. *schirasiana* Jan, 1863 (under *Sphalerosophis* [sic]) as not available (nomen nudum); they thought Jan's (1865) text in the 'viaggio in Persia' to be the "original description" and *schiraziana* [sic] with the "type locality Persia" the correct name of the taxon ("the provenance of the [sic] type specimen" is further commented in Leviton *et al.*, 1992). The feminine form (Jan, 1863, 1865) is in accordance with the gender of the Latin word 'varietas', and the correct subspecific name is *schirasianus*.

As is generally the case with the 'Elenco' (Jan, 1863), collection data (origin and location: "M.", i.e., MSNM) are brief and the diagnosis of *Periops parallelus schirasianus* Jan, which comes along with the one for *P. parallelus* Duméril, Bibron & Duméril, is concise: four or more prefrontals, twelve supralabials, none in contact with orbit ("Prefrontali più di 4; sopralabiali 12. Nessuno dei quali a contatto dell'occhio"). We understand that this meets the provision of Art. 12.1 (ICZN, 1999: the "new name [...] must be accompanied by a description or a definition of the taxon that it denotes") and renders Jan's (1863) name available. The careless handling of orthography in those times is exemplified by Jan's (1865) *P. parallellus* [sic] or Jan & Sordelli's (1867) "*schirazana*", a lapsus probably penned by the illustrator Ferdinando Sordelli (Schätti *et al.*, 2009a). We do not concur with Anderson & Leviton (1969) that "var. *schirasiana* Jan, 1863, Elenco Sist. delgi [sic] Ofidi" was a nomen nudum, and there is no reason to apply Art. 33.3.1 (ICZN, 1999: "when an incorrect subsequent spelling is in prevailing usage and is attributed to the publication of the original spelling", it "is deemed to be a correct original spelling") because the adscription to Jan (1863) is not given.

A similar case is *Zamenis* [*Platyceps*] *rhodorachis* Jan, 1863 also described from "Schiraz". Boulenger's (1893) 'Catalogue', to cite a milestone work, gives the 'viaggio in Persia' (Jan, 1865) as the original reference. However, the 'Elenco' provides an unambiguous diagnosis of this species (number of supralabials and midbody dorsal scale rows as well as, by implication, the peculiar dorsal colour pattern of the typical morph consisting of a red mid-dorsal stripe) and *rhodorachis* Jan, 1863 is definitely no nomen nudum, nor dubious (something never

claimed to be the case by any zoologist, to make it clear). We conclude that this name and *Periops parallelus schirasianus* were almost universally associated with Jan (1865) due to ignorance or negligence (Schätti *et al.*, 2010). A further instructive example to illustrate the confusion surrounding the author, year of publication, and spelling of *Spalerosophis diadema schirasianus* is found in Strauch's (1873: 106, 109) 'Schlangen des Russischen Reichs' where "1867. [...] Jan. Iconographie des Ophidiens Livr. XX, pl. II" is quoted in the synonymy of *Z. cliffordii* although "Jan. Elenco [...] p. 60" and "Filippi. Viaggio [...] p. 356" are cited in two footnotes regarding its distribution; the "Varietas *schirazana*" [sic] "Jan" appears in the text.

Jan (1865) stated that he had caught sight of numerous individuals ("molti exemplari da me veduti") but this may not necessarily have been the case two years earlier. By all means, there is no evidence of how many specimens Jan (1863) had seen or examined when describing the taxon, and any type material of *Periops parallelus schirasianus* formerly hold in the Milan collection (MSNM), possibly including one of the two snakes (see below) figured in Jan & Sordelli (1867: Pl. II), is lost (Scali, 1995).

Based on an original label ("Originaletikette") reading "Teheran, Nordpersien, 1863. Coll. Doria. No. 37. *Periops parallelus* Geoff. var. *shiraziana* [sic] Jan. Tipo. juvenil. Determ. Jan", Kramer & Schnurrenberger (1963) designated a male ("Arbeitsnummer [SK] 3323") of the MSNG 30350-51 series ("Syntypenreihe", five specimens) from the vicinity of Teheran as the lectotype of *P. p. schirasianus* Jan. This action neglects Recommendation 74E ('Verification of locality') of the 'Code' (ICZN, 1999).

Kramer & Schnurrenberger (1963) listed five tag numbers (SK 3322-3326) for six individuals. SK "3326" from the "Krasnovodsky Plateau" (Turkmenistan) is SK 1126, i.e., MHNG 1375.61. According to Giuliano Doria (in litt.), the actual SK 3326 (MHNG 1375.62) belonged to one out of two specimens registered under MSNG 30351 (30350 following Kramer & Schnurrenberger, 1963); reversely, SK 3323 is part of the MSNG 30350 series (3 specimens), not 30351. In the chapter dealing with *Sphalerosophis* [sic] *diadema cliffordi* [sic], Kramer & Schnurrenberger (1963: 526) used the term "*schirazianus*-Rasse", but in a comment regarding the type series of *Zamenis rhodorachis* Jan and the usage of 'type' by Giorgio (Georg) Jan in the sense of syntypes ("„Tipo" ist hier mit Syntypus und nicht etwa mit Holotypus zu übersetzen"), the taxon is named *S. d. shiraziana* [sic], i.e., the specific spelling found on the label of the putative syntype series.

Contrary to other members of the 1862 Italian mission to "Persia" (e.g., Filippo De Filippi, Michele Lessona) who returned that same year (except the diplomatic staff headed by Marcello Cerutti), Marquis Giacomo Doria spent wintertime in southern Iran (e.g., De Filippi, 1862, 1863; Branca, 1869). He collected natural history items along the way (e.g., around Esfahan [Isfahan], Hamadan, Shiraz, and Yazd) to the Persian Gulf and back to the Teheran area including, for instance, "Veramin" (Varamin, 35°20'N 51°39'E) in spring 1863 (Blanford, 1876: 144, 288). This expedition to as far as the Strait of Hormoz (Bandar Abbas) also passed through Lorestan as evidenced by the lectotype of *Spalerosophis microlepis* Jan. Although we were unable to trace the itinerary of Doria's homeward journey and determine the month of his arrival in Italy, this time schedule casts legitimate doubts on the likelihood that his herpetological specimens found their way into the 'Elenco' (Jan, 1863). Furthermore, Capocaccia's (1961) catalogue of the Genoa type collection does not cite *Periops parallelus schira-*

*sianus*, strengthening the case against the taxonomic status of MSNG 30350-51 as argued by Kramer & Schnurrenberger (1963), and we do not consider Diadem snakes from "Teheran" collected by G. Doria to belong to the type series of *P. p. schirasianus*.

Kramer & Schnurrenberger (1963) identified "SK 3323" with the smaller specimen illustrated in Jan & Sordelli (1867: Pl. II.B) but their unnumbered table on page 528 gives a snout-vent length of 1'100 mm for "MSNC [sic] 3323", actually the largest size for any Diadem snake of the MSNG series (coll. Doria); thirteen supralabials are tabulated. However, the 'Iconographie générale' depicts a halfgrown specimen from "Schiraz" (instead of "Teheran") with twelve supralabials on the left side (eleven of regular shape plus one triangular scale wedged in between the tenth and last). Contrary to the original description ("sopralabiali 12"), the larger snake (Jan & Sordelli, 1867: Pl. II.A) exhibits only ten supralabials on both sides and it remains unclear which specimen figured in the 'Iconographie générale' is, or was, deposited in the MSNG ("collection Doria, à Gènes").

### Morphological Variation

The analysis of dorsal and lateral head scales as well as ventral, subcaudal, and msr counts of *Spalerosophis diadema* ssp. compiled for this study resulted in the data shown in Tbs 1-2.

Table 1. Number of scales in prefrontal region, supralabials, and perioculars of *Spalerosophis diadema* ssp. from southern Iraq to Pakistan (see text, Material and Methods). Mean and number of specimens in parenthesis. *Coluber diadema* Schlegel: lectotype fide Russell (1807); *S. d. cliffordii* (Schlegel): Schmidt (1930), Corkill (1932), Hellmich (1959), Marx (1959), Afrasiab & Ali (1989); *S. d. schirasianus* (Jan): Jan (1863), Jan & Sordelli (1867), Blanford (1876, 1881), Boettger (1888), Werner (1895), Zugmayer (1905), Lantz (1918), Werner (1936), Mertens (1940), Schmidt (1955), Hellmich (1959), Kramer & Schnurrenberger (1963), Anderson & Leviton (1969); 'eastern *diadema*' (*S. d. diadema* auct.): Günther (1864), Khan (1986), Baig & Masroor (2008).

| Taxon | prefrontals | supralabials | perioculars |
|---|---|---|---|
| *Coluber diadema* | 7 (1) | – | – |
| *S. diadema cliffordii* | 4-6 (5.0, 3) | 10-12 (11.6, 16) | 6-11 (8.6, 18) |
| *S. d. schirasianus* | 4-7 (5.0, 15) | 10-14 (11.9, 23) | 7-11 (8.9, 21) |
| 'eastern *diadema*' | 5-7 (6.0, 5) | 10-14 (12.2, 5) | 7-8 (7.8, 4) |

Hellmich (1959) reported partial contact of the larger prefrontals with the frontal in *Spalerosophis diadema cliffordii* from Khuzestan (see Discussion). *S. d. schirasianus* usually shows five prefrontals including a transverse row of three smaller scales separating the larger anterior scales from the frontal (e.g., Jan & Sordelli, 1867: Pl. II; Blanford, 1876, 1881; Boettger, 1888; Zugmayer, 1905; Werner, 1936; Mertens, 1940). A "large snake" from Iran ("Persia") has "the central supplementary shield [...] irregularly divided" (Blanford, 1876). Werner (1895) observed five small scales behind the two regular prefrontals ("hinter den gut entwickelten Praefrontalen fünf kleinere Schildchen") in an incomplete specimen (head only) from Kerman Province. Mertens (1940) mentioned two Diadem snakes which appear to have just one or two small supranumeral scutes, i.e., one (the right) of the larger prefrontals in contact with the frontal, and in two *S. diadema* from near Kerman and the vicinity of Shiraz (Dehbid)

"the post-frontals [prefrontals] are in contact with the vertical [frontal]" (Blanford, 1876, 1881). Counting the "frontonasals" (see Terminology), Baig & Masroor's (2008) values for prefrontals (5-6) of 'eastern *diadema*' agree with an indication in Khan (1986: "six"). Günther (1864) reported "a transverse series of four small shields" (actually, there is an additional granule in the illustrated specimen) between the larger prefrontals ("anterior frontals") and the frontal ("vertical") in Diadem snakes from 'British India' (see Discussion).

Summary data for the number of supralabials are 10-12 (mean 11.1, n=9: Marx, 1959; see also Khalaf, 1960) in *Spalerosophis diadema cliffordii*, 12-14 (12.4, 12: Schmidt, 1939; Marx, 1959) for *S. d. schirasianus*, and 10-13 (11.8, 6: Marx, 1959) in 'eastern *diadema*'. As few as six perioculars in *S. d. cliffordii* from Iraq (Marx, 1959) is most probably based on an anomaly in FMNH 11067 collected at Kish (32°32'N 44°42'E); this specimen shows six on one side (left) but nine on the other (Schmidt, 1930). Khalaf (1960) gave seven to nine scales around the eye for Iraqi specimens. The single count of eleven perioculars in *d. cliffordii* is from USNM 121592 (Ahvaz, Iran). Marx's (1959) condensed compilation for *d. schirasianus* from the Teheran area notes 7-11 (mean 9.0, n=12) perioculars but Schmidt (1939) gave "six to 10" for this series. Zugmayer (1905) found eleven scales in a specimen from Chardzhev ("Tschardschuj") on the Amu Darja in eastern Turkmenistan, and eight to eleven perioculars are observed in Pakistani *schirasianus* (Minton, 1966). Data for 'eastern *diadema*' (Tb. 1) are from Günther (1864: Pl. XXI.G) and Baig & Masroor (2008) but up to eleven perioculars are reported (see Discussion).

Populations of *Spalerosophis diadema cliffordii* from southern Iraq and Khuzestan differ from *S. d. schirasianus* and 'eastern *diadema*' in their low number of subcaudals (less than 75 in the area under consideration). Diadem snakes from Turkmenistan to Pakistan have more ventrals than *d. cliffordii*, and 'eastern *diadema*' show more subcaudals and a higher mean for ventrals vis-à-vis *d. schirasianus* (Tb. 2). The latter has fewer msr than the western and eastern subspecies, and the maximum (31) is attained by a single record (♀) from Fars (Boulenger, 1893); our mean (27.3) closely agrees with condensed data in Schmidt (1939) and Marx (1959), i.e., 27.0 and 27.2, respectively (genders combined).

Boulenger (1893: letter v) classified a Diadem snake from "Persia" with 230 ventrals as a female; it is grouped as 'unsexed' due to doubts (Tb. 2). Counts of most female *Spalerosophis diadema schirasianus* do not exceed 245; one from Dehbid (30°38'N 53°13'E, Fars) has 248 ventrals (Boulenger, 1893: letter w, collector not indicated), another from Birjand in Khorasan has 252 (Mertens, 1956).

Potential intergrades between *Spalerosophis diadema schirasianus* and 'eastern *diadema*' from "Afghanistan" and Baluchistan (Pakistan, see Discussion) are not included in the analysis (Tbs 1-2). Sexual dimorphism is found in the means of ventrals of all three subspecies; the maximum (238) reported by Marx (1959) for male *S. d. schirasianus* (237 fide Schmidt, 1939) requires confirmation. The same count (238), possibly also comprising the preventrals, is found in the paralectotype of *Coluber diadema* Schlegel (fide Russell, 1807) considered to be a female. *S. d. schirasianus* and 'eastern *diadema*' hardly show any significant difference in subcaudals between males

TABLE 2. Gender, number of ventral, subcaudal, and midbody dorsal scale rows of *Spalerosophis diadema* ssp. from southern Iraq to Pakistan (see text, Material and Methods). Mean and sample size in parenthesis. *Coluber diadema* Schlegel: lectotype (♂) and paralectotype (probably ♀) fide Russell (1807); *S. d. cliffordii* (Schlegel): Corkill (1932), Hellmich (1959), Marx (1959) [includes data of Schmidt, 1930], Afrasiab & Ali (1989); *S. d. schirasianus* (Jan): Strauch (1873), Blanford (1876), Boettger (1888), Boulenger (1893), Zugmayer (1905), Lantz (1918), Werner (1936), Mertens (1940), Schmidt (1955), Mertens (1956), Hellmich (1959), Marx (1959) [material of Schmidt, 1939], Kramer & Schnurrenberger (1963), Minton (1966) [Las Bela (Ormara) and Quetta area, n=4], Anderson & Leviton (1969), Mertens (1969) [SMF 57340: Jiwani]; 'eastern *diadema*' (*S. d. diadema* auct.): Günther (1864), Boulenger (1893), Wall (1911b), Marx (1959), Minton (1966) [Rawalpindi and Swat (Udigram), n=3], Mertens (1969) [SMF 50454, 57337, 63044: Quetta area (Urak) and vic. Mansehra], Khan (1986), Baig & Masroor (2008).

| Taxon | gender | ventrals | subcaudals | dorsals (msr) |
|---|---|---|---|---|
| *Coluber diadema* | ♂ | 220 | 61 | - |
| | ♀ (?) | 238 | - | |
| *S. diadema cliffordii* | ♂♂ | 214-228 (218.2, 11) | 70-74 (72.1, 10) | 29-33 (30.7, 23) |
| | ♀♀ | 223-236 (227.9, 8) | 64-73 (67.3, 7) | |
| | unsexed | 220-224 (222.3, 4) | 65-72 (69.0, 5) | |
| *S. d. schirasianus* | ♂♂ | 214-238 (?) (226.2, 32) | 76-93 (84.6, 28) | 25-29 (rarely 31) (27.3, 40) |
| | ♀♀ | 234-252 (241.6, 18) | 77-87 (82.8, 16) | |
| | unsexed | 230-242 (236.0, 6) | 80-90 (85.0, 9) | |
| 'eastern *diadema*' | ♂♂ | 233-245 (240.1, 16) | 101-110 (105.6, 11) | 29-31 (29.5, 34) |
| | ♀♀ | 244-255 (249.5, 19) | 101-108 (104,6, 12) | |
| | unsexed | 244-246 (245.0, 2) | 95-109 (102.0, 2) | |

and females. The number of midbody dorsal scale rows (msr) is virtually identical for both genders of all three subspecies.

## DISCUSSION

The somewhat negligent description of *Coluber diadema* Schlegel reflects the way how that account came about, i.e., in the absence of physical evidence. Apart from ventral and subcaudals counts, the description is devoid of scale data. In particular, the complete separation of the larger prefrontals from the frontal is not mentioned, and it remains mysterious how Schlegel (1837) incorrectly established the condition of the dorsal scales (pretended to be keeled, see footnote 1). This and the dorsal colour pattern including head markings were considered diagnostic for the species ("peuvent servir de caractère à l'espèce").

Schlegel (1837, vol. 2) and Duméril *et al.* (1854) emphasized that cephalic scale features separate *Coluber cliffordii* and *Periops parallelus*, respectively, from all (!) other colubrines ("peut servir de guide pour la reconnaître parmi toutes les autres Couleuvres"; "Cette espèce [...] peut être distinguée de toutes les Couleuvres"). However, contrary to Schlegel (1837) who merely referred to lateral head scales (see Early Descriptions), the assertion of Duméril *et al.* (1854: "Ces différentes anomalies [...] constituent un caractère particulier de cette espèce") explicitly includes the incidence of usually two supranumeral scutes on the pileus ("le plus souvent, onze plaques sus-céphaliques") as formerly averred by Geoffroy Saint-Hilaire (1827: "plaques du dessus de la tête présentent quelques differences que la figure 1' exprime parfaitement").

Schlegel (1837) deemed small irregular head scales ("tête [...] revêtue de petites écailles de forme irrégulière") an exclusive character state of *Coluber cliffordii* ("propre à l'espèce") but only secondary labials and loreals, perioculars, and temporals are mentioned in the text ("[...] occupent la place des lames du frein, des oculaires et des temporales") and depicted in the illustration. In any event, contemporary authors followed the far more meticulous and reliable description of the junior synonym *Periops parallelus* Duméril, Bibron & Duméril and paid surprisingly little attention to data (e.g., the maximum for subcaudals) and indications as the absence of supranumeral scutes in Schlegel (1837). Boettger (1888), for example, distinguished the nominal species "*Zamenis versicolor* Wagl." (i.e., *C. cliffordii*, see Early Descriptions) and *Z.* [auct.] *diadema* (comprising "var." *schirazana* [sic]) by the number of subcaudals, i.e., 74 or less versus 77-110, respectively. These data largely concur with the morphological boundary between *Spalerosophis diadema cliffordii* and more eastern Diadem snakes including *S. d. schirasianus* as demonstrated in this paper (Tb. 2, see penultimate paragraph below).

The diagnosis of *Periops parallelus schirasianus* Jan is short and simple (see Early Descriptions) and the more elaborate account in Jan (1865) entirely concerns with a comparison vis-à-vis Diadem snakes from "Egitto" (Egypt). Apart from differences in dorsal colour pattern, *schirasianus* is characterized ("può essere ritenuata per un buon carattere per distinguere dalle altre la varietà della Persia") by the separation of the proper prefrontals from the frontal, i.e., the virtually exclusive ("così costante") incidence of at least three supranumeral scutes (Jan, 1863).

Due to terminological confusion, the interpretation of information about the number of certain head scales from literature is sometimes a matter of guesswork, and many important papers on Diadem snakes (e.g., Schmidt, 1930, 1939; Marx, 1959; Minton, 1966) do not address, for instance, the configuration of scales in the prefrontal region. Minton's (1966) data for these scutes and the perioculars ("eight to 11" each) of 'eastern *diadema*' are definitely higher than documented in this study (Tb. 1), possibly to some degree due to our limited sample size (see Material and Methods). Marx's (1959) periocular data (9-11, mean 9.7) for 'eastern *diadema*' may include juvenile or subadult *Spalerosophis atriceps* (see Systematic Concept: second paragraph).

Forcart's (1950) remark regarding the separation (!) of the prefrontals from the frontal in three *Spalerosophis diadema schirasianus* (i.e., all except NHMB 14325) by

a single (!) intermediary scale ("Frontale durch ein Zwischenschildchen von den Praefrontalia getrennt") is irreproducible and requires re-examination of the specimens. This is also the case with three *S. d. cliffordii* from Khuzestan reported by Hellmich (1959) which have, depending on the terminology applied in their description and the interpretation thereof, a total of four to six or five to eight (including four flanking scales) prefrontals ("Praefrontalia links und rechts von zwei hintereinander stehen Schildchen flankiert"). The more cautious approach (4-6 scales), compatible with our findings (Tb. 1) and eliminating the possible inclusion of upper loreals (see Terminology), is taken in this analysis, but the state of affairs in Khuzestan and other areas needs careful consideration.

Considerable variation in the shape of the parietal is exemplified by the type series of all nominal species-group taxa examined for this study (Figs 1-2; Russell, 1807: Pl. XXX; Jan & Sordelli, 1867: Pl. II, including supposed syntype). In the case of *Coluber cliffordii* Schlegel and *Periops parallelus* Duméril, Bibron & Duméril, the last periocular is deeply wedged in between the supraocular and parietal in, for example, RMNH 467A and MNHN 3571; other specimens have the lateral edges of the parietals conspicuously reduced along its entire length (RMNH 467B) or at least constricted posteriorly (MNHN 3572-74, 1999.8250). Similar variation is observed in *Periops parallelus schirasianus* Jan & Sordelli; the lectotype of *C. diadema* Schlegel shows distinct reduction, i.e., a series of detached scales all along the exterior borders of the parietals.

Data for body scales (Tb. 2) clearly corroborate the validity of *Spalerosophis diadema schirasianus* (see smallprint below) and numeric results of Schmidt (1939) and Marx (1959), i.e., a small gap in subcaudal counts separating *S. d. cliffordii* of southern Iraq and Khuzestan (less than 75) from *S. d. schirasianus* (76 or more); these taxa are also distinct in their means of msr counts. 'Eastern *diadema*' show at least 95 subcaudals vis-à-vis fewer in *d. schirasianus* as well as more ventrals and msr (means); this morphological boundary slightly differs from the value (100) in Marx (1959). A more precise determination of the distinctive parameters between *schirasianus* and 'eastern *diadema*' and their geographical distribution requires larger samples (e.g., from the Baluchistan Region) and analyses of additional characters.

Due to their low number of subcaudals, we follow Mertens (1969) and classify two *Spalerosophis diadema* (SMF 50403 [♂], 50452) from southern Baluchistan (Pakistan) with 97 each (no other data reported) as intergrades between *S. d. schirasianus* and 'eastern *diadema*'. However, we consider problematical Mertens's (1969) allocation of SMF 57337 ("s.ad.") and 63044 (♀) from the vicinity of Mansehra (34°20'N 73°12'E) in North Pakistan with 244-248 ventrals, 95-102 subcaudals, and 29 msr to *schirasianus*. These counts and further data from the same general area (Boulenger, 1893: two specimens from "Punjab") as well as the over-all ranges (including material from northern Pakistan) reported by Marx (1959) and Minton (1966) qualify populations of Diadem snakes from Punjab, Northwest Frontier Province, and Chitral (Wall, 1911b) as 'eastern *diadema*'.

We believe that Afghan populations of 'eastern *diadema*' are restricted to the border areas with northern Pakistan. Two specimens from Jalalabad (Nangarhar Province, no morphological data indicated) in Northeast Afghanistan "show identical

characters" with "the nominate subspecies" (Král, 1969), i.e., probably at least 234 (in case of ♂♂) or 246 (♀♀) ventrals and more than 100 subcaudals (Marx, 1959). However, a male (FMNH 161057) from the Kabul area (Paghman) with 227 ventrals and 27 msr (subcaudals incomplete) fits *Spalerosophis diadema schirasianus* (Anderson & Leviton, 1969). A subadult (♀?) Diadem snake in the BMNH collection from "Afghanistan" with 247 ventrals, 100 subcaudals, and 27 msr (Boulenger, 1893: letter ζ) not included in our analysis (Tb. 2) may be an intergrade based on its low number of dorsal scale rows, but the maximum at midbody (see Terminology) requires verification. The unlocated specimen (♂) with 237 ventrals and 110 subcaudals from "Afghanistan" or Karachi ("Kurrachee") described by Günther (1864) is tentatively assigned to 'eastern *diadema*'; it cannot be completely ruled out that one or several of his individuals from Sind (Karachi) belong to *S. atriceps*. Due to notorious confusion of these species, this study does not address the detailed distribution limits of *S. diadema* to the east, probably situated in Northwest India (see Systematic Concept: second paragraph).

The data compiled for this study clearly demonstrate that the supposedly lost type series of *Coluber diadema* Schlegel (see Early Descriptions: first smallprint) has definitely less ventrals (220-238, possibly encompassing preventrals) than 'eastern *diadema*', and the subcaudal count of 61 (Russell, 1807) in the lectotype is far too low vis-à-vis *Spalerosophis diadema schirasianus* and 'eastern *diadema*' (Tb. 2) as highlighted by Lanza (1964). Thus, the origin of *C. diadema* Schlegel, i.e., the vicinity of Bushehr (Russell, 1807), remains questionable. A juvenile male "*Spalerosophis shirazianus*" [sic] from near "Bushire" reported by Schmidt (1955) has 87 subcaudals and 228 ventrals, prompting Leviton *et al.* (1992) to indicate *S. d. schirasianus* from "the coastal plain [...] in the vicinity of Bushire" (their comment regarding Schmidt's data set and status of the taxon ["this subspecies"] is inaccurately formulated; two out of three specimens including one from the Teheran area are "in bad state" [Schmidt, 1955] and without data). This poses the question whether the seaport might just have been the place of dispatch of "Mr." Bruce's shipment (Russell, 1807), and it cannot be completely excluded that the type series of *C. diadema* was not collected in the immediate surroundings of Bushehr. In this context, it is necessary to emphasize that no further individual body scale data for *S. diadema* from along the Persian Gulf are known for the time being (Rajabizadeh *et al.*, 2008: map). For the sake of completeness, the reader should also be reminded that the illustration in Russell (1807: Pl. XXX) shows an apparently undamaged tail with 63 (instead of 61) paired subcaudals, and as few as 60 are found in Jan & Sordelli's (1867: Pl. II.B) smaller *schirasianus* from "Schiraz". Two exceedingly low counts (66, 60) from "Karmán" (Blanford, 1876) and Fallujah (Corkill, 1932) were omitted from analysis (see Terminology).

The number of midbody scale rows in the type series of *Coluber diadema* Schlegel is not documented, nor did the description pay attention to "an unusual row" of scales behind the larger prefrontals (Russell, 1807). The lectotype has five supranumeral scutes (see Early Descriptions) but this condition, as well as the total number of scales in the prefrontal region, do not permit a definite conclusion as to its probable origin. In view of the exceedingly low number of subcaudals, it cannot be completely ruled out that the type series of *C. diadema*, and in particular the male lectotype, was collected between Bushehr and Fars (Shiraz). We are not aware of any published body scale data from that area; although Werner (1917) quoted "*Zamenis diadema*" obtained at "Tangistân" near Ahram (Bushehr Province) and "Buschähr" from field notes of

Friedrich Carl Andreas, no preserved material is present in this collection. Should Russell's (1807) specimens actually originate from generally north of Bushehr, *Periops parallelus schirasianus* Jan could turn out to be a junior synonym of *C. diadema* Schlegel. This would nolens volens corroborate Baig & Masroor's (2008) attitude, which is entirely based on the supposed type locality and, unspoken, sympatry with *Spalerosophis diadema schirasianus*. By all means, these authors did not explicitly provide a rationale for their conclusion that "*schirazianus* [sic] is a junior synonym" of *diadema*; this opinion is due to a lack of comparative material and a biased systematic concept, namely the uncritical allocation of all Pakistani Diadem snake populations to the nominate subspecies of *S. diadema*. To judge from their text and data, Baig & Masroor (2008: 110, Fig. 6, Tb. 1) did not examine any *schirasianus* at all. PMNH 1922-23 with 246-255 ventrals, 107-109 subcaudals, and probably 29 msr (see Terminology) from Karak at "the western boundary of Pakistan, adjacent to Afghanistan" belong to 'eastern *diadema*'; they are assumed to come from near 33°07'N 71°06'E or 34°26'N 72°44'E in the Northwest Frontier Province, and not from Karak in Baluchistan (30°20'N 66°44'E).

At any rate, the subcaudal count of the lectotype of *Coluber diadema* Schlegel renders illusory the distinctive feature between *Spalerosophis diadema cliffordii* and *S. d. diadema* sensu stricto, and morphological data (ventral and subcaudal counts) of *C. diadema* best fit Diadem snakes from Khuzestan and southern Iraq. If this turned out to be correct, western populations (*S. d. cliffordii* auct.) should be allocated to the nominate subspecies (e.g., Chernov, 1959; Lanza, 1964; see Schätti *et al.*, 2009b). Awaiting further field work in, or the study of museum material from, the northern Persian Gulf and areas farther inland, we respect conventional usage for western Diadem snakes from Khuzestan to the west (*S. d. cliffordii*) and recommend to refer to 'eastern *diadema*' as *S. d. diadema* auct. In any event, the latter require a new name and further decisions regarding the subspecific allocation of populations from Iraq and Khuzestan depend upon comparison with Clifford's Diadem snake from North Africa to Arabia (see below).

To the best of our knowledge, the only potentially available name for 'eastern *diadema*' is *Zamenis diadema* var. *melanoides* Wall, 1914 earlier described as variety "C" (Wall, 1911a), but this taxon is supposed to be a junior synonym of *Spalerosophis atriceps* (Fischer). Uniting all populations of Diadem snakes from the southeastern Caspian area and the Zagros Range to the east under *S. diadema schirasianus* while maintaining *S. d. cliffordii* for populations from Iraq and Khuzestan would result in the suspension of the nominotypical subspecies.

Irrespective of the erroneous assumption regarding the type locality of *Spalerosophis diadema* ("near Bombay"), Marx (1959) is correct that *S. d. schirasianus* proves to be "morphologically intermediate" between the western *S. d. cliffordii* and *S. d. diadema* auct. "of Pakistan and India [...] in ventral and caudal counts of both sexes". However, Schmidt's view (1939) that *schirasianus* "may be more closely allied to the true *diadema* [auct.] (of north-western India)" is possibly more precise, at least to judge from morphological characters analyzed by us as well as biogeographical considerations.

The distinction between *Spalerosophis diadema cliffordii* and *S. d. schirasianus* entirely relies on differences in subcaudal counts (Schmidt, 1930, 1939; Marx, 1959). "The reference of specimens from Iraq to *cliffordii* instead of to *diadema* auct. is made necessary by the recognition of *schirazianus* [sic] from Iran, inserted between the type locality of *diadema* (Bombay) [!], and the Iraqi (Mesopotamian) area", but Schmidt (1939) admitted that this "is by no means a completely satisfactory allocation. The

alternative is to give a new name to the form in the Euphrates Valley [!], and it is preferable to reserve the proposal of additional names for a more comprehensive revision pending which trinominals are avoided." We take this opportunity to clarify that the situation in Iraq is more complex than described so far. Corkill (1932) reported a probable female Diadem snake from As-Sulaymaniyah (35°34'N 45°26'E) in Northeast Iraq with 233 ventrals, "87" subcaudals (possibly 78), and as many as 35 msr. It differs from all *cliffordii* analyzed within the scope of this study (Tb. 2) and specimens from Southeast Turkey and Syria with 202-219 ventrals (♂♂ 202-205, ♀♀ 215-219), 65-72 subcaudals (69-72, 65-72), and 29-32 (29-31, 31-32 [maximum probably 33 as indicated in Schätti *et al.*, 2009a: 131-132 [key]) msr (Eiselt, 1970; Baran, 1982; Franzen, 1999; Baran *et al.*, 2004; Sindaco *et al.*, 2006). These latter populations differ vis-à-vis *cliffordii* auct. from the area under consideration in distinctly lower ventral counts. It is noteworthy that Marx's (1959) working sample of *cliffordii* includes FMNH 19596 from Sinjar in western Kurdistan.

Species status for *Coluber cliffordii* Schlegel (see Systematic Concept: fifth paragraph) is not an idea to be a priori rejected but we refrain from any decision concerning its systematic status because this study does not scrutinize morphological variation in populations from North Africa, in particular Libya (type locality: Tripoli), to the Near East nor resolve the quandary regarding the correct scientific name of Diadem snakes from west of a line along the Zagros Range to Bushehr Province as explained in this paper.

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